Equipment Ownership Reflects Changing Requirements

by Dean Hale, *Editor*

Construction equipment survey

Notable changes in construction equipment utilization and ownership are taking place within gas distribution utilities. They are being caused by the added replacement, maintenance, and repair—coupled with regulatory constraints.

More than 202,750 units of construction equipment, major tool items, and units of transportation equipment are presently owned by the nation's 1560 gas distribution utilities. While total unit ownership has declined since 1974, the companies are using bigger, more productive equipment and have streamlined their construction operations.

Greater use of plastic pipe for mains and services—up from 51% of all piping in 1974 to 89% in 1983—has meant less need for heavy equipment to handle plastic pipe that weighs much less than steel or cast iron, less need for welding equipment, and reduced need for pipe coating and wrapping equipment.

More versatile equipment, such as the combination front-end loader and trencher or the tractor with with front-end loader and backhoe, along with items such as small, portable service line plows have led utilities to operate with smaller crews and less equipment.

Construction Practices

Gas utilities install 42% of their new and replacement mains and distribution contractors install 58%. The utilities install a larger share of the service lines — 66% — with distribution contractors installing 33%, plumbers 1%.

Respondents to PIPELINE & GAS JOURNAL'S Construction Equipment Survey serve 23,340,900 customers — 48% of the industry total — and these respondent utilities added 231,515 customers in 1982, over 54% of the total added during that year.

Survey respondents installed 43% of the 11,268 miles of new and replacement mains installed in 1982, and 37% of the 12,341 miles of new and replacement service lines installed during that year.

The "mix" on pipe sizes continues to change in the gas utility business, as shown in this table:

1982	1974	1969	1964	1961
62% was 2-in or smaller	66	55	44	49
34% was 3-in. to 8-in.	31	39	47	42
4% was 10-in. and over	3	6	9	9

Smaller pipe continues to be more widely used. Key reason is that utilities are increasing their operating pressures, automatically increasing the capacity of lines without using larger diameter pipe.

Service lines installed in 1982, by size:
- 96% was 1½-in. or smaller
- 4% was 2-in. or larger.

For each new customer added in 1982, gas utilities in the P&GJ survey installed:
- 102 ft of new main (compared to 86 ft in 1974, 128 ft in 1969, and 129 ft in 1964).
- 98 ft of new service line (compared to 86 ft in 1974, 84 ft in 1969, and 80 ft in 1964).

Methods and equipment used for various types of excavation for gas mains and services are shown in the accompanying tables.

Equipment Ownership

Gas utilities are major users of construction equipment, specialized tools, and transportation equipment. For example, these utilities own:
- 1 unit of construction equipment for every **1512** customers
- 1 unit of specialized construction or maintenance tool for every **474** customers
- 1 unit of transportation equipment (truck, auto, or trailer) for every **610** customers.

Total tractor ownership by the gas utilities is down about 20% since 1974. The decline has been in both track-type tractors (down 52%) and in wheel-type machines (down 5%). Fewer track-type tractors are being used because more plastic pipe is being installed.

Attachments used on the track-type units include front-end loaders (58%), hydraulic backhoes (26%), sidebooms (21%), and dozer blades (58%). On the wheel-type tractors, 66% are equipped with front-end loaders, 44% have hydraulic backhoes, 7% are fitted with sidebooms, and 8% have dozer blades. Gas utilities are major users of self-propelled forklift units and reported a 141% increase in ownership from 1974 to 1982.

Trencher ownership declined 18% in total numbers, but that's misleading, because much of the decline came in the number of mobile trencher attachments used on tractors, jeeps, and similar vehicles. An increase of 36% occurred in the categories of wheel-type, track-mounted, ladder-type and wheel or truck-mounted ladder-type. Ownership of small, portable, gasoline-engine powered chain-type trenchers declined 23%; many utilities have "moved up" from the smaller one-person, handlebar guided units to one-man riding-type units that are more versatile and more powerful.

The gas utilities also reported a 54% increase in ownership of other excavating equipment, principally backhoes that are crawler-mounted, carrier-mounted, or self-propelled.

How Does Your Utility Compare To The Average?

Ownership on a "miles of main" basis for major equipment categories, based on the P&GJ survey, reveals:

Equipment Item	1 Unit Owned For Every
Tractors	166 miles of main
Trenchers	286 miles of main
Excavating/Backhoes	280 miles of main
Cranes	380 miles of main
Pipe Plows	1452 miles of main
Tampers	121 miles of main
Air compressors	111 miles of main
Tools (all types)	8 miles of main
Welding equipment	106 miles of main
Automobiles	36 miles of main
Trucks	16 miles of main
Trailers	400 miles of main

Ownership of cranes jumped 174% with big increases in self-propelled units, truck-mounted units, truck-bed-mounted hydraulic cranes (up 179%), and self-propelled hydraulic cranes (up 155%).

Pipe plowing remains a popular method of installing both plastic and coated steel pipe, but the number of plowing-in units has diminished by 42%. Vibrating plows remain the most popular type.

Gas company ownership of pneumatic tampers dropped 47% since 1974, while gasoline-powered tampers increased 137%.

Air compressor numbers dropped 11% since the last P&GJ Construction Equipment Census was conducted, and while the numbers are smaller, the sizes of units owned are much larger. Emphasis appears to have been on replacing older, smaller capacity units with new, larger capacity machines.

(Continued)

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Who Installs Gas Mains?

Pipe Size	Company Forces	Outside Contractors
2-in. and under	53%	47%
3-in. to 8-in.	42%	58%
10-in. and over	13%	87%
All sizes (total pipe)	**47%**	**58%**

Who Installs Gas Service Lines?

Company Forces	66%
Contractors	33%
Plumbers	1%

Excavation Methods

% of Pipe Installed — As Reported By Companies

	Bell Hole	Service Lines	Mains to 4-in.	Mains over 4-in.
By hand	4%	6%	1%	2%
Tractor-mounted backhoe	63%	19%	36%	35%
Small portable trencher	5%	36%	16%	7%
Machine trencher (wheel or ladder-type)	7%	9%	17%	20%
Backhoe, self-propelled or truck-mounted	21%	14%	18%	26%
Boring equipment	—	9%	7%	6%
Plowing-in	—	5%	2%	2%
Other	—	2%	3%	2%

Tools — pneumatic, gasoline engine driven, pipe handling/cutting/coating and wrapping and other specialized items such as pipe locators, x-ray machines, road boring units, and pipe tapping and plugging machines — have essentially remained constant in total numbers. Changes in the "mix" of such tools reflect changing needs of gas utility construction operations.

Even though plastic pipe has replaced steel and cast iron as the major piping material for gas mains and services, welding is still required for both new and replacement and repair work. Total welding units owned — both a.c. and d.c. welding generators — decreased only 4%, while the number of oxy-acetylene welding units increased by 12%.

Transportation Equipment

Only a slight decline in the number of passenger vehicles operated by gas utilities was reported — a decrease of 9% in the total. The number of leased vehicles increased from 7% in 1974 to 30% in 1982. Most popular body styles are standard 4-door sedans (27%), compact 4-door sedans (33%), and compact 2-door sedans (14%).

Trucks operated decreased only 1% in total numbers, but the percentage of leased vehicles rose from 7% in 1974 to 32% in 1982. In size, 69% of the trucks have gross vehicle weight of 10,000 lb or less; 14% have GVW of 10,000 to 19,500 lb, and 17% are heavier than 19,500 lb.

Pickups remain the most popular body style of trucks operated by gas utilities — 41%, followed by closed vans 19%, vehicles with service bodies — 15%, and vehicles with crew bodies — 13%.

Trailer ownership is down 30%. Most popular trailer model is the flat bed — 48% of the total owned, followed by pipe/pole trailers — 26% of the total.

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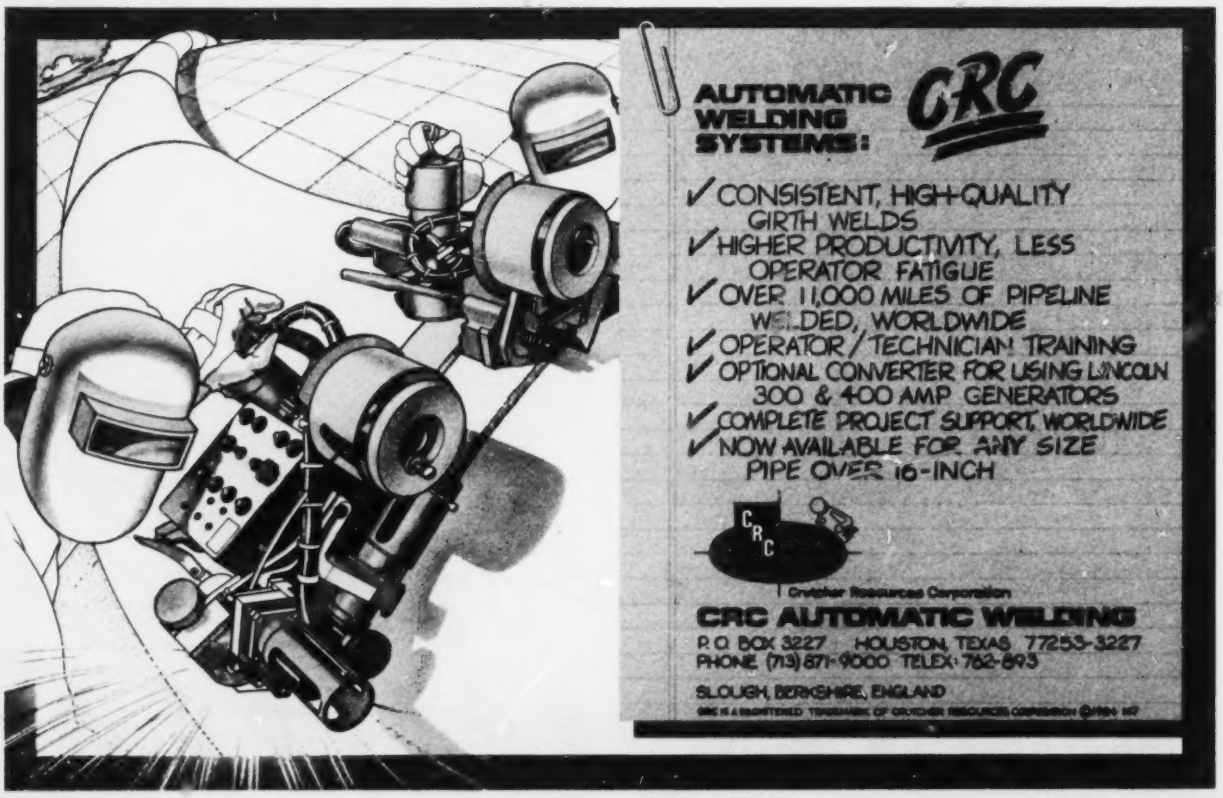
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Oil Companies Post Higher Earnings

Oil companies posted a modest increase in net income for the second straight quarter.

The 84 companies responding to our survey reported $8.5 billion in earnings for the third quarter, a 9.5% increase over the same period in 1982. Profit margin for the group rose from 5.1% to 5.5%.

Improved U.S. oil and chemical markets, higher crude oil production, cost-cutting and productivity gains helped Exxon earn 21% more in the third quarter.

Mobil's 42% increase is attributed to substantial gains in foreign petroleum earnings.

Lower financing expenses and corporate overhead, combined with better refining and marketing results gave Sun a 10% earnings rise.

Phillips Petroleum's net income jumped 15% due to higher crude oil production following the acquisition of General American Oil.

Lower crude oil prices and natural gas demand were blamed for the 2% drop in earnings at Shell Oil.

Texaco's net income increased 9% as a result of improved production and downstream earnings.

Standard Oil of Ohio's earnings dropped 11% due to lower income from exploration and production operations, lower crude oil prices, and higher exploration expenses.

Lower operating and administrative costs plus improved productivity paid off for Gulf Oil. Earnings increased 74%.

Standard Oil of Indiana posted

GAS COMPANIES' THIRD QUARTER FINANCIAL REPORTS

Company	Three months ending Sept. 30 Revenues ($MIL) 1983	1982	%CHG	Earnings ($MIL) 1983	1982	%CHG	Nine months ending Sept. 30 Revenues ($MIL) 1983	1982	%CHG	Earnings ($MIL) 1983	1982	%CHG	Profit Margin 1983	1982
Alabama Tennessee N.G.	28.2	29.6	-4.5	1.3	1.3	0.5	101.7	96.6	5.2	4.4	4.4	-0.1	4.3	4.5
American Nat. Resources	666.2	510.8	30.4	18.8	0.8	2250.0	2393.3	2257.5	6.0	111.1	95.3	16.6	4.6	4.2
ARKLA[1]	257.0	274.6	-6.4	7.7	12.4	-38.3	1306.5	1262.7	3.5	78.2	93.6	-16.5	6.0	7.4
Coastal Corp.	1365.9	1317.3	3.7	24.1	21.2	13.7	4308.8	4218.0	2.2	69.3	43.0	61.1	1.6	1.0
Columbia Gas	765.4	793.1	-3.5	4.5	-15.6		3486.4	3662.9	-4.8	96.9	115.4	-16.1	2.8	3.2
Consolidated Natural Gas	477.4	498.1	-4.2	5.2	6.2	-16.7	2420.8	2327.3	4.0	139.7	118.1	18.2	5.8	5.1
The El Paso Company	1124.1	1067.8	5.3	25.1	32.7	-23.4	3331.2	3175.1	4.9	62.2	72.1	-13.7	1.9	2.3
ENSERCH	886.2	968.3	-8.5	17.3	31.3	-44.9	2680.0	2874.2	-6.8	66.3	124.6	-46.8	2.5	4.3
Houston Natural Gas[2]	722.5	728.3	-0.8	26.3	59.6	-55.9	2962.4	3180.7	-6.9	190.2	262.3	-27.5	6.4	8.2
InterNorth	985.9	803.1	22.8	30.1	17.2	74.8	3403.8	2970.6	14.6	164.2	150.5	9.1	4.8	5.1
KN Energy	110.2	109.2	0.9	8.6	4.1	111.7	495.8	484.9	2.2	32.1	24.8	29.1	6.5	5.1
Mountain Fuel Supply[1]	105.7	90.8	16.4	0.4	2.3	-83.6	630.8	526.4	19.9	58.2	37.7	54.3	9.2	7.2
NOVA, An Alberta Corp.	891.0	859.0	3.7	35.0	40.0	-12.5	2880.0	2447.0	17.7	104.0	99.0	5.1	3.6	4.0
ONEOK Inc.	203.5	206.8	-1.6		7.8	-99.4	805.4	833.2	-3.3	20.8	41.6	-50.1	2.6	5.0
Pacific Lighting	1067.3	1027.1	3.9	36.6	22.5	62.9	3415.3	3208.3	6.5	110.8	83.7	32.3	3.2	2.6
Panhandle Eastern	666.0	757.1	-12.0	22.1	48.5	-54.5	2433.1	2506.2	-2.9	110.6	184.5	-40.1	4.5	7.4
Pioneer Corp.	272.6	303.4	-10.2	18.6	26.1	-28.6	779.8	835.2	-6.6	60.2	72.6	-17.0	7.7	8.7
Sonat Inc.	561.6	563.1	-0.3	50.4	48.3	4.3	1988.5	1990.1	-0.1	168.6	160.6	5.0	8.5	8.1
Southern Union Co.	202.1	223.4	-9.5	0.4	0.4	1.4	789.8	817.3	-3.4	18.5	16.1	14.9	2.3	2.0
Texas Eastern Corp.[1]	1300.8	1315.0	-1.1	56.1	43.3	29.6	5517.6	5394.2	2.3	138.1	208.1	-33.6	2.5	3.9
Texas Gas Resources	497.6	650.8	-23.5	23.5	25.7	-8.5	1929.5	2107.4	-8.4	53.1	83.9	-36.7	2.8	4.0
TransCanada Pipelines	775.2	752.0	3.1	57.4	49.6	15.7	2414.5	2567.2	-5.9	160.7	138.9	15.7	6.7	5.4
Transco Energy Co.	797.8	927.7	-14.0	30.0	30.4	-1.3	2850.0	2808.4	1.5	91.7	108.3	-15.3	3.2	3.9
Union Gas Ltd.[3]	187.1	159.7	17.2	1.5	-1.3		432.6	368.5	17.4	8.7	4.1	110.7	2.0	1.1
United Energy Resources	843.9	1287.5	-34.5	-18.1	40.6		2976.3	4237.5	-29.8	33.8	159.1	-78.8	1.1	3.8
Westcoast Transmission	193.2	151.5	27.5	15.5	17.3	-10.7	703.2	791.3	-11.1	48.6	55.0	-11.7	6.9	7.0
TOTAL	15954.4	16375.0	-2.6	498.4	572.7	-13.0	57437.2	57948.6	-0.9	2200.9	2557.4	-13.9	3.8	4.4

[1]Twelve months. [2]Ends July 31. [3]Six months.

Third Quarter Report

OIL COMPANIES' THIRD QUARTER FINANCIAL REPORTS

Company	Three months ending Sept. 30 Revenues ($MIL) 1983	1982	%CHG	Earnings ($MIL) 1983	1982	%CHG	Nine months ending Sept. 30 Revenues ($MIL) 1983	1982	%CHG	Earnings ($MIL) 1983	1982	%CHG	Profit Margin 1983	1982
Adams Resources & Energy	45.8	46.0	-0.3	0.4	-2.9		134.4	151.5	-11.2	-0.2	-2.7			
Adobe Oil & Gas	41.3	51.2	-19.4	5.6	5.8	-2.7	124.4	154.9	-19.7	16.7	35.3	-52.6	13.4	22.8
Amerada Hess	2352.8	2124.1	10.8	75.1	80.1	-6.2	6100.8	6277.7	-2.8	148.3	125.0	18.6	2.4	2.0
American Petrofina	565.1	540.1	4.6	23.0	12.7	81.0	1583.5	1723.3	-8.1	31.9	39.6	-19.4	2.0	2.3
American Quasar	9.2	12.9	-28.7	0.4	-0.3		29.9	41.4	-27.8	-3.3	1.2			2.9
Argo Petroleum	5.0	6.0	-16.7	-0.6	-0.6		15.0	17.0	-11.6	-2.3	-1.6			
Asamera	111.5	126.7	-12.0	4.4	4.0	7.6	298.2	350.0	-14.8	0.4	4.1	-89.6	0.1	1.2
Ashland Oil	2147.3	2269.7	-5.4	45.8	49.5	-7.6	6028.4	6700.5	-10.0	40.3	75.9	-46.9	0.7	1.1
Atlantic Richfield	6378.4	6659.4	-4.2	405.1	446.9	-9.4	19220.8	19895.4	-3.4	1128.8	1242.1	-9.1	5.9	6.2
Beard Oil	7.6	8.1	-5.6	-0.6	-0.9		23.0	26.9	-14.6	-1.8	-0.3			
Buttes Gas & Oil	31.8	36.0	-11.7	0.4	0.4	8.8	95.9	119.7	-19.9	1.8	1.1	60.4	1.9	0.9
Callon Petroleum[1]	6.9	4.9	39.6	0.3	-0.2									
Commonwealth Oil Refining	0.9	21.9	-95.9	-4.9	-5.9		18.5	288.1	-93.6	-11.5	-22.1			
Consolidated O & G	9.5	9.1	4.5	0.2	-1.5		28.2	30.6	-8.0	-0.5	-3.8			
Crown Central Petroleum	471.1	450.2	4.6	3.6	8.4	-56.9	1170.9	1279.5	-8.5	-3.9	1.5			0.1
Crystal Oil	50.7	46.8	8.3	-1.5	1.7		144.8	152.9	-5.3	-2.7	-0.2			
Diamond Shamrock	1014.5	733.2	38.4	39.7	42.3	-6.1	2848.3	2422.0	17.6	73.9	138.9	-46.8	2.6	5.7
Dorchester Gas	259.5	283.8	-8.5	6.2	3.2	93.4	1369.8	1159.1	18.2	17.7	17.8	-0.9	1.3	1.5
Dyco Petroleum	11.4	15.2	-24.6	1.8	4.1	-55.6	35.1	43.7	-19.7	6.1	11.9	-49.3	17.2	27.3
Energy Reserves Group	34.8	39.6	-12.3	2.6	0.1	1861.9	107.8	121.4	-11.2	9.1	-0.2		8.4	
ENSTAR Corp.	74.2	82.8	-10.3	7.2	11.5	-37.1	226.9	262.3	-13.5	20.4	31.0	-34.1	9.0	11.8
Equity Oil	5.6	5.6	-0.2	1.1	0.2	455.1	16.4	17.3	-5.4	3.3	1.9	75.1	20.3	11.0
Exxon	23342.0	25203.0	-7.4	1225.0	1017.0	20.5	28.0	77165.0	-9.4	3360.0	2705.0	24.2	4.8	3.5
Felmont	20.1	18.8	7.2	4.1	3.8	6.0	59.3	58.0	2.3	10.9	10.8	1.2	18.4	18.6
Forest Oil Corp.	30.6	40.2	-23.9	2.1	4.7	-54.5	97.0	116.1	-16.4	7.5	9.9	-24.1	7.7	8.5
Freeport McMoRan	194.7	186.1	4.6	26.6	19.7	34.8	585.1	556.1	5.2	67.1	61.7	8.8	11.5	11.1
Galaxy Oil	3.6	3.8	-6.8	-0.4	-0.5		9.3	10.7	-12.7	1.3	2.0	-31.0	14.4	18.3
Getty Oil	2939.5	3109.7	-5.5	183.7	182.3	0.8	8965.0	9378.9	-4.4	255.5	518.9	-50.8	2.8	5.5
Gulf Oil Corp.	7514.0	7547.0	-0.4	276.0	159.0	73.6	21401.0	22498.0	-4.9	681.0	674.0	1.0	3.2	3.0
Hadson Petroleum	5.1	5.5	-8.8	4.6	2.0		17.0	24.9	-31.7	-11.7	11.2			45.2
Hamilton Bros. Petroleum	42.0	37.2	12.8	1.9	4.5	-59.0	118.0	126.1	-6.5	12.8	8.9	44.2	10.8	7.0
Helmerich & Payne	51.8	89.0	-41.8	10.4	18.6	-43.8	184.7	279.6	-33.9	37.2	62.2	-40.1	20.2	22.2
Hershey Oil	2.1	1.6	36.4	0.2		662.5	5.8	5.2	10.9	0.7	0.4	73.4	11.5	7.4
Holly Corp.[2]	102.1	100.9	1.2	-0.3	-2.2		341.1	339.3	0.5	4.7	5.1	-7.6	1.4	1.5
Howell Corp.	34.9	53.3	-34.6	0.4	0.4	3.9	108.8	184.1	-40.9	0.7	1.9	-61.9	0.7	1.0
Howell Petroleum	13.9	13.2	4.8	1.9	1.5	25.6	51.9	56.9	-8.9	6.4	6.0	6.0	12.3	10.6
Inexco Oil	42.4	51.5	-17.7	3.0	2.8	9.8	128.4	170.1	-24.5	9.4	14.8	-36.6	7.3	8.7
Kerr-McGee Corp.	898.3	913.5	-1.7	39.7	56.8	-30.1	2584.4	2762.0	-6.4	101.3	136.2	-25.7	3.9	4.9
Lear Petroleum	69.1	54.4	27.1	7.0	1.5	360.6	178.2	157.3	13.3	15.7	0.3	6088.1	8.8	0.2
Louisiana Land & Exp.	313.6	259.1	21.0	24.2	19.2	25.9	877.9	873.9	0.5	75.1	53.1	41.5	8.6	6.1
Mapco Inc.	540.8	489.6	10.5	13.6	20.2	-32.7	1518.1	1452.2	4.5	38.0	54.1	-29.8	2.5	3.7
May Petroleum	10.3	7.6	35.6	0.1	-0.2		25.4	22.7	12.1	-1.6	0.8			3.4
Maynard Oil	6.2	6.8	-8.8	0.7	-0.3		21.7	26.2	-17.4	-1.0	-1.0			
MCO Holding	39.3	43.9	-10.5	0.6	3.1	-80.4	122.6	131.1	-6.5	7.7	9.9	-22.8	6.2	7.6
Mesa Petroleum	95.0	99.7	-4.7	44.2	29.4	50.2	302.9	303.7	-0.2	97.1	91.2	6.5	32.1	30.0
MGF Oil	14.0	25.1	-44.5	-19.5	-19.7		47.9	83.4	-42.6	-43.3	-21.8			
Mitchell Energy & Dev.	226.0	239.8	-5.8	20.1	23.7	-15.5	705.0	705.9	-0.1	58.4	57.9	0.9	8.3	8.2
Mobil Corp.	14200.0	15400.0	-7.8	404.0	284.0	42.3	42900.0	47600.0	-9.9	1056.0	815.0	29.6	2.5	1.7
Moran Energy	20.5	20.9	-1.5	1.0	0.5	105.6	64.4	74.3	-13.2	3.2	6.4	-50.4	4.9	8.6
Murphy Oil	565.7	641.0	-11.8	39.8	43.9	-9.4	1894.9	1983.9	-4.5	108.0	119.0	-9.2	5.7	6.0
Noble Affiliates	73.2	94.9	-22.9	5.7	17.7	-67.6	221.0	317.3	-30.3	18.7	60.4	-69.1	8.4	19.0
Norris Oil	636.6	695.6	-8.5	-205.3	87.0		2081.5	2032.6	2.4	-147.4	98.8			4.9
Occidental Petroleum	4908.0	4412.5	11.2	151.8	25.1	504.8	14413.8	12924.5	11.5	320.7	153.6	108.8	2.2	1.2
Oxoco	12941.2	10467.8	23.6	2282.6	1820.2	25.4	35350.9	26823.4	31.8	6312.9	5252.7	20.2	17.9	19.6
Pennzoil Co.	587.2	563.5	4.2	34.6	52.5	-34.0	1714.4	1739.4	-1.4	103.3	135.2	-23.6	6.0	7.8
Petro-Lewis[3]	83.9	78.7	6.6	1.6	2.8	-42.9								
Petroleum Devel.	3.2	4.0	-18.3		-0.1		11.6	10.2	13.4	0.4	-0.5		3.4	
Phillips Petroleum	3890.0	3996.0	-2.7	176.0	153.0	15.0	11316.0	11829.0	-4.3	474.0	491.0	-3.5	4.2	4.2
Prairie Producing Co.	5.0	6.5	-23.3	0.8	1.3	-35.4	14.4	20.0	-28.2	2.4	3.4	-30.5	16.4	17.0
Quaker State	226.2	245.5	-7.9	9.3	11.5	-19.4	685.1	718.8	-4.7	27.5	31.4	-12.3	4.0	4.4
Sabine Corp.	25.1	29.2	-13.9	3.2	-0.9		83.3	83.1	0.2	10.0	0.2	3997.1	11.9	0.3
Seneca Oil	3.3	4.9	-31.5	2.0	2.6	-21.5	12.2	15.7	-21.9	5.3	4.7	12.4	43.6	30.3
Shell Oil	5122.0	5090.0	0.6	449.0	442.0	1.6	14638.0	15037.0	-2.7	1084.0	1166.0	-7.0	7.4	7.8
Southland Royalty	77.7	86.8	-10.5	4.8	7.0	-30.8	239.9	274.6	-12.6	20.0	23.8	-16.0	8.3	8.7
Southwestern Energy[4]	10.8	12.2	-11.3	1.7	2.1	-19.6	70.7	59.4	19.1	13.9	11.6	19.8	19.6	19.5
Standard California	7654.0	8666.0	-11.7	509.0	459.0	10.9	21741.0	28056.0	-22.5	1187.0	952.0	24.7	5.5	3.4
Standard Indiana	7201.0	7677.0	-6.2	584.0	559.0	4.5	22083.0	22400.0	-1.4	1409.0	1411.0	-0.1	6.4	6.3
Standard Ohio	2995.0	3317.0	-9.7	435.0	487.0	-10.7	8862.0	10313.0	-14.1	1188.0	1415.0	-16.0	13.4	13.7
Statex Petroleum[5]	3.0	2.5	22.7	-0.5			9.5	9.5	-0.6	-1.2	1.4			14.8
Sun Co.	3770.0	3950.0	-4.6	167.0	152.0	9.9	11290.0	12160.0	-7.2	392.0	386.0	1.6	3.5	3.2
Superior Oil	469.7	499.8	-6.0	117.6	39.1	200.9	1345.8	1536.4	-12.4	178.0	199.4	-10.7	13.2	13.0
Tenneco	3433.0	3631.0	-5.5	144.0	182.0	-20.9	10608.0	11083.0	-4.3	475.0	531.0	-10.5	4.5	4.8
Tesoro Petroleum	989.4	636.9	55.3	18.1	12.6	43.7	2826.6	2469.2	14.5	48.4	48.1	0.6	1.7	1.9
Texaco Inc.	10567.0	11833.0	-10.7	331.0	303.0	9.2	30623.0	36312.0	-15.7	977.0	975.0	0.2	3.2	2.7
Texas American Energy	31.3	38.7	-19.0	-2.1	-1.5		148.1	153.5	-3.6	-0.8	-1.4			
Tosco Corp	539.4	902.0	-40.2	1.4	22.1	-93.7	2013.1	2552.2	-21.1	-240.2	129.4			5.1
Total Petroleum N.A.	540.9	553.2	-2.2	11.3	8.3	36.6	1551.7	1649.3	-5.9	-35.1	7.5			0.5
Union California	2730.0	2770.0	-1.4	180.2	212.8	-15.3	8010.0	8160.0	-1.8	447.9	578.9	-22.6	5.6	7.1
Universal Resources	10.9	13.9	-21.8	-0.7	1.5		34.7	45.5	-23.8	-2.0	6.7			14.8
Wainoco Oil	11.0	11.5	-4.8	0.2	-3.3		33.9	37.8	-10.4	1.4	-9.7		4.1	
Wilshire Oil of Texas	2.5	3.4	-27.6	0.4	0.4	0.7	7.5	9.8	-23.0	1.6	1.1	51.3	21.3	10.8
Wiser Oil	12.3	13.1	-5.7	2.2	2.2	-0.8	40.0	40.9	-2.2	8.6	9.4	-8.9	21.4	23.0
Woods Petroleum	16.9	19.8	-14.6	2.5	4.9	-48.3	52.1	61.0	-14.5	10.2	16.5	-38.1	19.6	27.1
Worldwide Energy	18.0	15.0	19.4	1.0	0.6	63.4	54.0	41.4	30.3	-0.4	-0.4			
TOTAL	134561.2	138577.4	-2.9	8327.1	7595.0	9.6	395051.8	417356.3	-5.3	21720.4	21199.2	2.5	5.5	5.1

[1]Ends Aug. 31. [2]Ends April 30. [3]Year ends June 30. [4]Twelve months. [5]Ends July 31.

5% higher net income due to improved refined product margins and increased earnings from chemical operations.

Lower crude oil prices, higher oil and gas production expenses, and lower petroleum product margins were responsible for Atlantic Richfield's 9% drop in net income.

Occidental Petroleum's third quarter earnings jumped 505% as a result of the acquisition of Cities Service.

Improved refining and marketing margins and lower exploration expenses combined for an 11% increase at Standard Oil of California.

Getty Oil's net income was $184 million compared to $182 million in the third quarter of 1982.

Lower sulphur and natural gas volumes translated into a 34% decline in net income for Pennzoil.

Diamond Shamrock's earnings dropped 6% as strong competition in refined product markets kept a lid on profit margins.

Operating income from all three segments of American Petrofina's operations improved in the third quarter as earnings rose 81%.

Declines in oil and gas operations and contract drilling and trucking subsidiaries caused Noble Affiliates' net income to plunge 68%.

Louisiana Land and Exploration had fewer dry holes plus reduced losses from mining operations. Earnings increased 26%.

Beard Oil reported a net loss of $635,000 in the third quarter. Earnings were adversely affected by a decline in oil and gas sales and drilling and well servicing revenues.

Continued pressure on refined product margins was cited for the 57% decline at Crown Central Petroleum.

Moran Energy's higher production levels resulted in an increase of 106%.

The 26 gas companies in our survey posted a 13% decline in net income in the third quarter. Profit margin for the group fell from 4.4% to 3.8%.

Consolidated Natural Gas posted a 13% decline in earnings due to depressed conditions in the manufacture and marketing of equipment.

Southern Union reported a $373,000 loss, as oil refining and marketing continued to be depressed.

Lower earnings and sales volume resulted in net loss of $18 million for United Energy Resources.

The El Paso Company's net income fell 23% due to lower production volumes and reduced sales to their interstate pipeline.

Improvement in the natural gas pipeline business helped Texas Eastern earn 30% more in the third quarter.

Union Gas earned $1.5 million compared to a net loss in 1982. Increased gas sales and higher customer rates were the main contributors.

Sonat posted a 4% increase due to adjustments relating to settlements of outstanding regulatory matters and tax issues.

Improvement in Coastal's refining, marketing, and natural gas systems segments resulted in 14% higher earnings.

Columbia Gas System earned $4.5 million compared to a $15.6 million loss in 1982. ■

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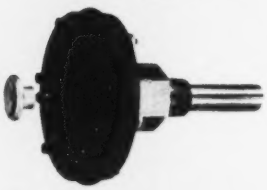

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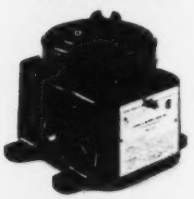

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MARCH 1984 • VOLUME 211 • NUMBER 3

Newsreel 2
Highlights of month's news

Government Guidelines 4
State & Federal regulatory memo

Upstream 6
Future events in today's news

Reflections 8
A glimpse of 50 & 100 years ago

MCF 10
Industry news/developments

Projects 14
New systems/expansion/developments

Meetings 40

People On The Move 41

Bookshelf 42

Advertiser's Index EM10

Energy Management Report

Comment EM 1

Energy World Report EM 2

Fourth Quarter Report EM 3

Financial Notebook EM 4

Classified EM 5

New Products EM 5

COVER

Repairing, replacing, and rehabilitating gas mains and service, as well as cross-country pipelines, has become a fulltime big business. Typical gas utility maintenance work is shown being done by Wisconsin Gas crews.

—photo by John W. Alley, Wisconsin Gas Company

NAPCA Special Section N1

Complete listing of all Regular, Affiliate, and Foreign Members of National Association of Pipe Coating Applicators, listing their headquarters, facilities, and capabilities, plus a list of domestic and foreign Associate Members. Special maps detail locations of headquarters and plant facilities.

New Life For Old Pipe 19

Seminar on retesting and requalification of older pipelines examines whys and hows of upgrading. Six key operating and engineering managers discuss the subject — the criteria used, the procedures involved.

Encapsulation Quickly Seals Leaking Cast Iron Pipe Joints 22

New technology, developed in the U.K., is helping The Peoples Natural Gas solve the problem of leaking joints in older cast iron distribution systems. Procedure makes possible permanent, economic, and easy repairs.

PE-Lined Pipe Overcomes Wet CO_2 Gas Line Problems 27

Wet carbon dioxide gas can literally eat steel pipe from the inside out. Polyethylene liner is helping solve this problem in an ARCO gathering system.

What's New In Maintenance And Repair Equipment, Materials 30

Many new products, equipment items, and services have been developed for all kinds of maintenance, repair, and replacement work by oil and gas pipelines and gas distribution utilities.

Jungle Pipeline Inspected By Camera Pig 34

Interior of Indonesian gas pipeline carefully checked for heavy oxide corrosion and other problems using special "camera pig" that photographs internal surface of pipe.

Engineered Coating Systems Protect Meters, Station Piping 39

Custom-designed protective coatings used to fight severe fading and chalking as well as abrasion from wind-driven sand on piping, valves, and other equipment at five city gate metering stations.

Substantial Drop in Net Income Reported

Fourth quarter earnings for the oil companies responding to Energy Management Report's exclusive survey declined substantially from the same period in 1982.

Net income of $1.0 billion was reported for the quarter compared to $3.16 billion a year earlier, representing a 68% drop. For the year, earnings fell to $12.0 billion from $20.2 billion in 1982, a 41% decline. Profit margin fell from 3.5% to 1.7%

Gas companies fared much better during the fourth quarter. Net income dropped slightly from $439.7 million in 1982 to $439 million in 1983. Earnings fell 13% for the year, however, from $2.1 billion in 1982 to $1.8 billion in 1983. Profit margin for the group fell from 4.8% to 4.2%

Exxon's 10% increase in net income resulted from higher oil production in the North Sea.

Lower operating and administrative costs and improved productivity helped Gulf Oil earn 31% more during the fourth Quarter.

A dry hole at Mukluk off the northern coast of Alaska caused some problems for several companies.

As a result, Texaco posted a 16% decline; Standard Oil of Ohio's earnings dropped 30%; and Diamond Shamrock reported a fourth quarter loss of $130 million.

Mobil Oil's earnings also suffered from the Mukluk dry hole, but their non-petroleum operations improved, so earnings increased 12%.

Recent weakening of petroleum prices combined with higher U.S. exploration expenses resulted in a 5% drop in net income for Standard Oil of California.

Standard Oil of Indiana posted 11% higher earnings. The increase was due primarily to greater foreign liquids production, improved refined product margins, and higher earnings from chemical operations.

Lower exploration costs contributed to Getty Oil's 39% increase in net income.

Improvement in Shell Oil's chemical business, increased crude oil production, higher natural gas prices, and improved refined product margins all had a positive effect on net income. Earnings rose 25%.

Sun Company's earnings were adversely affected by a drop in U.S. exploration and production profit. Net income fell 60%.

Lower crude oil prices and increased oil and gas operating and depreciation charges were responsible for Atlantic Richfield's 3% drop in earnings.

Ashland Oil's net income dropped

OIL COMPANIES' FOURTH QUARTER FINANCIAL RESULTS

	Three months ending Dec. 31						Twelve months ending Dec. 31							
	Revenues ($000)			Earnings ($000)			Revenues ($000)			Earnings ($000)			Profit Margin	
Company	1983	1982	%CHG	1983	1982	%CHG	1983	1982	%CHG	1983	1982	%CHG	1983	1982
Amerada Hess	2,621,305	2,116,414	9.68	57,006	43,613	30.72	8,422,076	8,394,065	0.33	205,347	168,662	21.75	2.44	2.01
American Petrofina	504,983	530,351	-4.78	23,362	14,835	57.48	2,088,526	2,253,678	-7.33	55,260	54,401	1.58	2.65	2.41
Anglo Energy[1]	37,683	51,666	-27.06	-19,726	-7,815	152.38	150,340	205,229	-26.74	-82,182	444	-18,609.46	-54.66	0.22
Ashland Oil	2,081,626	2,079,810	0.18	27,186	29,110	-6.61	8,111,985	8,780,339	-7.61	100,909	162,425	-37.87	1.24	1.85
Calion Petroleum[2]	3,613	5,896	46.08	1,169	-150	-879.33	27,580	20,747	32.93	1,515	349	334.10	5.49	1.68
Diamond Shamrock	1,177,767	755,339	55.93	-130,031	46,196	-381.48	4,026,107	3,177,379	26.71	-56,163	185,091	-130.34	-1.39	5.83
Dorchester Gas[2]	221,542	409,517	-45.90	2,174	5,613	-61.27	1,181,862	1,340,319	-11.82	14,213	17,975	-20.93	1.20	1.34
Exxon	24,663,000	26,394,000	-6.56	1,625,000	1,481,000	9.72	94,591,000	103,559,000	-8.66	4,985,000	4,186,000	19.09	5.27	4.04
Getty Oil	3,050,493	3,016,766	1.13	236,648	172,445	36.39	12,016,014	12,395,647	-3.06	493,466	690,712	-28.56	4.11	5.57
Gulf Oil Corp.	7,486,000	8,132,000	-7.94	297,000	226,000	31.42	28,887,000	30,630,000	-5.69	978,000	900,000	8.67	3.39	2.94
Helmerich & Payne	55,502	81,072	-31.54	10,576	13,516	-21.75	240,209	360,632	-33.39	47,000	75,690	-36.85	19.90	20.99
Holly Corp.[3]	103,444	112,777	-8.23	1,837	5,446	-66.26	444,643	452,073	-1.64	6,523	10,516	-37.97	1.47	2.33
Inexco Oil	44,454	47,478	-5.52	3,321	4,070	-23.32	173,240	217,539	-20.36	12,536	18,865	-33.71	7.22	8.67
Kerr-McGee Corp.	973,283	1,019,207	-9.05	17,141	73,515	-76.68	118,412	209,764	-43.55	17,141	73,515	-76.68	14.48	35.05
Louisiana Land & Exp.	376,401	331,302	13.61	18,900	23,173	-18.44	1,254,256	1,205,175	4.07	94,029	76,252	23.31	7.50	6.33
Maxus Inc.	546,567	540,791	1.06	16,042	19,695	-18.55	2,064,653	1,992,947	3.60	50,477	73,822	-31.62	2.44	3.70
Mobil Corp.	16,578,000	16,934,000	-5.78	448,000	399,000	11.61	66,515,000	64,106,000	-8.72	1,501,000	1,213,000	23.74	2.57	1.89
Murphy Oil	643,044	697,784	-27.17	23,883	38,807	-38.46	2,437,967	2,681,709	-9.09	131,676	157,759	-16.41	5.41	5.88
Nugget Oil Corp.[4]	739	3,100	-76.16	-761	-204	282.84	3,161	7,275	-70.29	1,449	-205	-806.83	57.05	-2.82
Occidental Petroleum	4,701,400	4,733,000	-0.66	240,000	1,000	12,200.00	191,157,000	17,657,000	982.58	566,700	155,600	264.20	0.30	0.88
Pennzoil	602,440	529,184	13.85	37,651	50,486	-14.19	2,315,833	2,268,511	2.13	164,235	186,713	-12.97	7.09	8.32
Quaker State	217,629	210,144	3.56	4,014	7,216	-25.76	902,690	928,933	-2.82	36,574	38,568	-5.17	4.05	4.15
Seneca Oil	3,416	5,792	-32.35	-1,210	-909	26.93	16,163	21,460	-24.75	-6,569	-5,717	14.90	-40.64	-26.61
Shell Oil	5,245,000	5,176,000	1.33	349,000	436,000	-25.34	19,983,000	20,214,000	-1.64	1,633,000	1,605,000	1.74	8.21	7.94
Standard California	7,441,000	7,887,000	-5.66	403,000	425,000	-5.18	34,182,000	35,943,000	-16.81	1,590,000	1,377,000	15.47	5.45	3.83
Standard Indiana	7,406,000	7,381,000	0.31	459,000	415,000	10.60	29,489,000	29,753,000	-0.89	1,868,000	1,826,000	2.30	6.33	6.13
Standard Ohio	3,205,000	3,216,000	-0.34	324,000	464,000	-30.17	12,067,000	13,529,000	-10.81	1,512,000	1,874,000	-19.53	12.53	13.84
Summit Energy[5]	11,404	12,614	9.76	-1,705	1,256	-235.75	3,413	3,060	27.67	-510	-159	220.75	-13.01	-5.19
Sun	4,230,000	4,190,000	1.17	61,000	151,000	-59.60	15,520,000	16,260,000	-4.55	453,000	537,000	-15.64	2.92	3.30
Superior Oil	447,465	504,113	-11.23	61,746	74,034	-16.59	1,793,332	2,040,518	-12.11	241,755	223,421	8.21	13.48	10.95
Tenneco	3,681,000	3,895,000	-5.49	273,000	226,000	20.80	14,448,000	14,979,000	-3.54	694,000	797,000	-13.61	4.81	5.25
Texaco Inc.	13,503,000	14,394,000	-13.06	456,000	325,000	-14.16	51,170,000	45,000,000	-14.37	1,211,000	1,241,000	-3.75	3.00	2.67
Texas Oil & Gas	487,561	430,184	13.35	74,874	66,624	15.82	1,428,614	1,865,841	-7.27	305,557	261,534	17.21	15.84	13.87
Tipperary Corp.	16,000,000	16,962,000	14.97	1,181,000	-2,334,000	-165.64	60,724,000	60,162,000	7.43	848,000	-5,501,000	-115.42	1.40	-9.14
Tosco Corp.	881,064	613,746	-47.35	-210,607	1,654	-3,633.37	2,494,200	3,465,946	-26.04	-378,298	132,404	-385.55	-15.16	3.82
Total Petroleum N.A.	420,211	481,772	-13.89	1,414	1,930	-26.82	2,071,957	2,233,556	-7.71	-11,151	12,762	-187.38	-1.50	0.57
Union California	2,840,400	2,736,150	2.03	374,000	470,000	-20.89	11,693,100	10,899,130	-1.89	575,900	604,000	-22.19	5.85	7.38
Universal Resources[6]	11,666,000	10,599,000	8.62	10,865,000	-115,000	9,550.00	40,151,000	54,117,000	-16.80	-7,448,000	6,609,000	-218.75	-16.73	11.37
Total	141,486,614	140,830,781	-1.81	1,004,824	3,143,410	-68.03	706,844,871	580,382,583	22.10	12,026,555	20,247,456	-40.60	1.73	3.58

[1] Ends Sept. 30 [2] Ends Nov. 30 [3] Year end July 31, 1983 [4] Six months ending Oct. 31 [5] Ends Oct. 31

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GAS COMPANIES' FOURTH QUARTER FINANCIAL RESULTS

Company	Three months ending Dec. 31						Twelve months ending Dec. 31						Profit Margin	
	Revenues ($000)			Earnings ($000)			Revenues ($000)			Earnings ($000)				
	1983	1982	$ Chg	1983	1982	$ Chg	1983	1982	$ Chg	1983	1982	$ Chg	1983	1982
Alabama Tennessee N.G.	36,060	36,277	-0.54	1,765	1,665	5.94	137,737	132,881	3.65	6,124	5,982	2.37	4.45	4.50
Atlagasco Inc.	47,062	41,829	5.70	848	822	3.16	400,424	351,349	13.32	6,261	6,012	4.14	1.56	1.70
American Nat. Resources	465,000	422,000	17.40	51,000	47,800	6.64	1,372,000	1,094,000	8.88	171,300	161,100	6.33	5.08	5.20
ANR,A	107,284	115,247	-2.83	-8,413	10,166	-187.67	1,297,541	1,295,584	3.07	94,123	95,380	-38.01	4.55	7.36
Columbia Gas	1,603,348	1,419,870	12.86	61,890	64,618	-5.03	5,101,242	5,133,256	-0.04	164,754	160,063	-8.50	3.23	3.53
ENSERCH Corp.	621,344	611,433	9.47	-3,011	21,059	-114.30	3,502,365	3,787,675	-7.53	60,760	145,612	-58.27	1.73	3.84
Entex Inc.	354,987	357,900	-0.81	22,667	13,827	64.04	1,293,141	1,264,291	1.88	63,155	57,334	10.15	4.88	4.52
Houston N.G.[3]	744,079	748,019	-0.53	47,491	58,648	-16.24	2,956,429	3,081,613	-4.00	179,519	249,569	-28.07	6.07	8.10
Intermountain Gas	36,028	43,234	-16.20	1,760	1,893	-7.02	132,871	149,111	-10.89	4,997	7,449	-32.92	3.76	2.98
MidCon Corp.[2]	637,076	581,464	9.56	NM 814	11,920	-93.28	3,318,975	3,337,430	-0.55	121,605	132,634	-8.31	3.66	3.97
ONEOK Inc.	297,263	255,822	16.38	14,137	8,113	74.25	1,102,703	1,088,620	1.29	35,761	49,988	-28.46	3.24	4.59
Panhandle Eastern	472,115	478,116	10.70	41,877	35,868	16.40	3,405,245	3,384,273	0.62	152,436	219,876	-30.67	4.48	6.50
Sonat Inc.	735,370	747,549	-1.63	41,508	43,999	-5.43	2,723,881	2,737,696	-0.50	210,223	204,639	2.73	7.72	7.47
Texas Eastern Corp.							5,393,045	5,654,353	-4.62	154,577	161,334	-4.19	2.87	2.85
Texas Gas Resources	627,019	627,236	-0.03	26,737	27,399	-2.42	2,262,618	2,304,526	+1.82	79,816	111,266	-28.27	3.53	4.83
TransCanada Pipelines	1,056,300	899,700	17.41	67,500	60,000	12.50	3,470,700	3,466,900	0.11	226,100	198,900	14.66	6.57	5.74
Transco Energy	995,000	1,061,000	-6.22	35,500	22,800	55.70	3,845,000	3,869,000	-0.62	133,000	137,000	-2.92	3.46	3.54
Union Gas Ltd.[3]	369,206	282,025	30.91	18,619	9,536	97.30	801,805	650,526	23.25	27,524	13,669	101.36	3.43	2.10
Total:	10,647,811	10,079,562	5.64	439,000	439,704	-0.20	44,519,729	44,764,086	-0.50	1,859,037	2,134,809	-12.90	4.20	4.80

1 Ends Oct. 31 2 Ends Sept. 30 3 Nine months

nearly 7% as a result of lower petroleum product margins.

Higher natural gas sales due to extremely cold weather and an increase in sulphur volumes took credit for Pennzoil's 14% rise in earnings.

American Petrofina's net income jumped 57% due to improvement in petrochemicals, production, and exploration segments.

Superior Oil's 166% increase reflects generally improved performance for most company operations.

Quaker State Oil Refining reported 26% higher earnings for the fourth quarter due to lower interest cost and taxes.

Callon Petroleum reported earnings of $1.17 million compared to a $150,000 loss in 1982. Higher earnings reflect increases in oil and gas sales and production volumes.

Lower crude oil and condensate prices and volumes, as well as lower natural gas volumes were blamed for Tenneco's 13% drop in net income.

Universal Resources posted a $7.85 million loss due to a $6.19 million (after tax) valuation reserve on the company's drilling rigs.

Anglo Energy's fourth quarter loss of $19.7 million included a provision of $14.4 million for the loss on the sale of Anglo Resources.

FINANCIAL NOTEBOOK

Consumers should not experience appreciably higher energy costs in 1984, despite an expected increase in oil consumption, according to Bank of America's Quarterly Energy Report.

The improved economies of the U.S., Japan, and Europe will trigger additional demand on the world market, but OPEC is expected to hold its price at $29/bbl to avoid losses similar to those brought on last year by the cartel's failure to reach an agreement on production.

The report also says the very slight increase in natural gas prices will not keep pace with inflation and in real terms, will actually decline. Permanent reductions in natural gas consumption by U.S. industries are partly responsible for the drop.

Mergers/acquisitions. Exploration Surveys completed the acquisition of Supreme Corp. for about $10.5 million.

Colorado Interstate (Coastal Corp.) commenced an offer to purchase up to 18.75 million shares of Houston Natural Gas common stock at $68/share.

Marine and Petroleum Equipment (Nantes, France) acquired Anglo Marine and Petroleum Equipment (Shreveport, La.).

ANR Technology (American Natural Resources) will acquire an interest in Nu-Tech Industries.

American Petrofina will purchase Champlin Petroleum's service stations/C-stores in 11 southwest and midwest states.

Minden Oil and Gas and Patton Oil agreed to discontinue merger negotiations.

MidCon (Chicago, Ill.) and Texas Oil & Gas (Dallas, Tex.) completed the acquisition of natural gas pipelines and other assets from seven units of Tatham Pipeline (Houston, Tex.) for $200 million each.

Denver Exploration agreed to acquire Fiesta Energy (Denver, Colo.).

Texaco plans to acquire the U.S. exploration and producing interests of Dome Petroleum (Calgary, Alberta).

Mesa Petroleum and other members of the Gulf Investors Group purchased 675,000 shares of Gulf Oil common stock for about 31.5 million.

Contracts. Texas Gas Gathering entered into a contract with Sun Exploration and Production to purchase all natural gas produced from a 6,400 acre block owned by Sun in Crockett and Val Verde Counties, Texas.

Energy and Resource Consultants (Boulder, Colo.) was awarded a $100,000 contract by Pacific Gas and Electric (San Francisco, Calif.) to analyze the effect of PG&E's Master Meter Conversion program on energy conservation within the utility's service territory.

C-E Lummus (Combustion Engineering) was awarded a contract by FMC Corp.'s Agricultural Chemical Group for the engineering, procurement, and construction of a $40 million plant expansion for the production of Furadan® in Baltimore, Md.

ISI, Inc. (Barnard and Burk Group) was awarded a contract to provide maintenance services at Chevron U.S.A.'s refinery in Salt Lake City, Utah.

Eastern Associated Coal (Eastern Gas and Fuel Associates) and ADDCO Mining agreed to enter into long-term mineral leases and purchase coal mining operations from Appalachian Power (American Electric Power).

Joint ventures. Brown & Root and a unit of Wharton Williams Holdings joined to form a new Dutch company, Deepwater Holdings BV.

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How To Modernize Compressor Stations
How To Cut Unaccounted-For Gas Losses
Soft Excavation Developments

PIPELINE & GAS JOURNAL

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in this issue

MAY 1984 • VOLUME 211 • NUMBER 6

Newsreel 2
Highlights of month's news

Government Guidelines 4
State & Federal regulatory memo

Upstream 6
Future events in today's news

Reflections 8
A glimpse of 50 & 100 years ago

MCF 10
Industry news/developments

Projects 14
New systems/expansion/developments

People On The Move 69

Bookshelf 71

Meetings 71

Advertiser's Index EM14

Energy Management Report

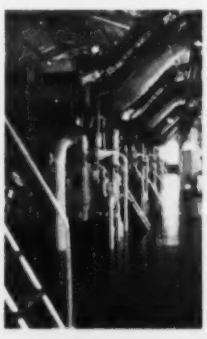
Comment EM 1

Energy World Report EM 2

Classified EM 4

Financial Notebook EM 5

New Products EM 6



COVER

Compressor station modernization is focused primarily on reducing fuel cost; P&GJ special report in this issue tells what's happening and how it is working.

—photo courtesy Consolidated Gas Transmission Co.

Compressor Station Modernization: The Key Is Cutting Fuel Costs 17

Determining the when, why, how, and how much of compressor station modernization or compressor unit overhaul/rebuilding/replacement is complicated because there are many variables involved; more efficient operation—to reduce fuel expense—remains an overriding consideration, and special P&GJ seminar panel tells why.

Yes, You Can Control Lost & Unaccounted For Gas 22

Lost and unaccounted for gas represents a big dollar loss to gas distribution utilities and gas transmission pipelines because, in a dozen years, the retail price of gas has increased to over $5 per Mcf. P&GJ's industry-wide investigation of the problem has uncovered almost two dozen ways to help cut L & U gas losses.

Rotary Digger, Vacuum Combined For Utility Soft Excavation 30

Accidental damage to buried gas mains and services can be prevented by "soft excavation" techniques, using a new combination of the hand-held rotary digger and the soil removing vacuum method.

Microprocessor-Based SCADA System Enhances Small Utility's Operations 34

A desktop business computer has been combined with digital telemetry, "smart" microproccessor remote terminal units, pressure, flow and temperature transmitters, and other components to provide a small, widespread utility with fulltime system scanning and logging and alarms.

Rankine Cycle Heat Recovery Adds 1000 HP In Compression 42

Natural Gas Pipeline Co. of America is using exhaust heat from its regular compressor engines to produce heat for a 1000-hp Rankine cycle turbine engine driving a centrifugal compressor.

How To Grout And Chock Mount Large Gas Engine Compressors 54

Growth in use of new types of epoxy grout products and applications sometimes makes it difficult for user to select the most suitable product; here's a guide to what's happened and what's happening.

Onsite Fuel Cell Power Plants Key To All-Gas Energy Services . . . . . 6[illegible]

Phosphoric acid fuel cells that convert natural gas to electricity are being field tested in anticipation of the day that the all-gas energy home will include providing power for your TV, stereo, lights, and dishwasher.

Special Report

Compressor Station Modernization: The Key Is Cutting Fuel Costs

by Dean Hale, *Editor*

When the cost of natural gas was less than 25¢ per Mcf, hardly anyone worried about the cost of fuel gas for compressors.

Or how efficiently they operated.

That's all changed.

Fuel cost is a major concern. The high price of natural gas in the field, in the pipeline, at the city gate, and at the customer meter has brought a new awareness. Pipeline operators well know that most compressor stations operating today were designed and built when gas was cheap.

Now they are seeking ways to improve operating efficiency and cut fuel costs. Modernization of compressor stations, including replacing or rebuilding/overhauling individual compressor units, is an attractive answer.

But capital costs are also a major worry. As a result, gas transmission pipeline company compressor superintendents have to juggle both problems to find solutions. Replacing old prime movers and compressors with newer units costs money . . . . lots of it. Modernization may still be the answer.

What's happening in the gas pipeline business isn't mysterious at all. It is simply that the decisions are complicated because of the many variables involved. When PIPELINE & GAS JOURNAL first began examining station modernization, it found some companies replace stations or units all at once, one or several at a time. Other companies have continuing maintenance and upgrading programs to keep everything up-to-date.

PIPELINE & GAS JOURNAL asked six top operating people concerned with compressor operations to participate in a seminar on compressor station modernization and how to do it better. Respondents participating in this seminar are from companies operating 201 compressor stations and a total of 2,665,260 hp. That's 6% of the industry's total number of compressor stations

Dick Bayley
Columbia Gulf Transmission Co.

John G. Frank
Great Lakes Gas Transmission Co.

John T. Hood, Jr.
United Gas Pipe Line Co.

Thomas E. Jacobs
Tennessee Gas Pipeline Co.

Don Pendelton
Consumers Power Co.

W.L. Upham
Houston Pipe Line Co.

U.S. Compressor Horsepower — 20 Largest Companies

Company Name	Horsepower	Stations			
		Total	Field	Storage	Mainline
ANR Pipeline Co.	1,110,000	96	48	10	38
Colorado Interstate Gas Co.	340,000	74	53	3	18
Columbia Gas Transmission Co.	513,525	177	48	27	102
Columbia Gulf Transmission Corp.	477,450	13	—	—	13
Consolidated Gas Transmission Corp.	279,669	63	5	17	41
El Paso Natural Gas Co.	1,400,000	120	63	2	55
Great Lakes Gas Transmission Co.	374,200	14	—	—	14
High Island Offshore System	460,000	1	—	—	1
Natural Gas Pipeline Co. of America	1,142,610	129	44	8	77
Northern Natrual Gas Co.	1,110,000	171	116	2	53
Northwest Central Pipeline Co.	350,000	76	35	6	35
Panhandle Eastern Pipeline Co.	928,364	223	148	5	70
Southern Natural Gas. Co.	386,690	36	—	1	35
Tennessee Gas Pipeline Co.	1,274,605	65	—	2	63
Texas Eastern Transmission Corp.	1,328,945	98	24	1	73
Texas Gas Resources Co.	490,000	40	1	11	28
Transcontinental Gas Pipeline Corp.	1,091,789	84	43	3	38
Transwestern Pipeline Co.	274,476	210	190	—	20
Trunkline Gas Co.	349,623	24	4	1	19
United Gas Pipe Line Co.	300,000	89	53	2	34

(3579) and 15% of its total horsepower (18,429,171 hp).

Seminar participants include **Dick Bayley,** Supervisor, Compressors, Columbia Gulf Transmission Co.; **John G. Frank,** Vice President, Engineering, Great Lakes Gas Transmission Co.; **John T. Hood, Jr.,** Assistant Superintendent, Compressor Stations, United Gas Pipe Line Co.; **Thomas E. Jacobs,** Compressor Superintendent, Tennessee Gas Pipeline Co.; **Don Pendleton,** Gas Compressor Superintendent, Consumers Power Co.; **W. L. Upham,** Manager—Compressors, Houston Pipe Line Co., and **Dean Nale,** Editor, PIPELINE & GAS JOURNAL.

Seminar questions and responses are:

P&GJ: *How do you decide what stations to modernize?*

Jacobs: Fuel cost is the biggest item in our operating and maintenance budget. It is important to keep fuel consumption at a minimum. We are adding fuel measurement devices to each engine. We are also adding microprocessor units to control engines. Overall, we plan to either bring units up to date or replace them.

Hood: Age, condition of the equipment, and economics are the basic criteria. Older stations become obsolete and repair parts are either very costly or hard to obtain.

Upham: Cost of fuel is the principal criterion. We make every effort to reduce this cost. Modernization is one approach.

Frank: Decision to modernize is based on three factors. If a major change in flows of gas occurs, operation of station will change, and may require new equipment. If maintenance of equipment at a station caused large amounts of unit downtime, that equipment will be modified or replaced. If energy costs increase, modification or replacement could be justified.

Pendleton: Decisions on stations that will be candidates for improvements are based on amount of improvement needed and operational cost savings that can be realized.

Bayley: Fuel efficiency is our biggest concern. Pipelines must have stations in operation and they need to do it efficiently. Age and condition are important as they influence efficiency.

P&GJ: *How do you calculate probable return on investment vs. operating cost savings?*

Hood: Our engineering planning section determines revenue required to support a project, taking into consideration capital cost, depreciation, fixed rate of return (usually obtained from latest rate filing with FERC), income taxes, *ad valorem* taxes, and operating expenses. We apply this computation to existing facilities and to several approaches to proposed new facilities. From the results we find one with lower cost while earning the required rate of return.

Upham: If the station load is improved, and fuel cost is reduced, we expect a return on the investment.

Bayley: Biggest operating cost savings we see would be in improving fuel efficiency of the units. Fuel gas is not going to become cheaper and the savings will pay for the investment.

Frank: We utilize an investment analysis computer model. This model issued to analyze various pipeline investment opportunities such as modifications, replacements, or additions. This allows us to determine a project's internal rate of return, net cash flow, and cost of service. From that we make a final decision.

Jacobs: It involves some difficult economic analysis and everyone does if differently. Analysis gives us choices; we then make a final decision.

Pendleton: Any investment in capital equipment must be justified on need. That need can include, in modernizing existing facilities, potential reduction in operating costs. These reductions are examined and projects that show the greatest improvement are implemented within capital limitations.

P&GJ: *How do you decide on replacement vs. rebuilding/overhaul?*

Hood: We overhaul reciprocating equipment (new rings, liners,

pistons, bearings, etc.) as needed. We go through a minor or major overhaul on our turbine equipment based on hours running time. Decision to replace equipment is based on the ability of the equipment to do the job it is called upon to do. If the equipment is in a bad state of repair or operating conditions have changed, it may be replaced.

Bayley: Progressive or continuous rebuilding of units has been our objective for a long time. This upgrading is selective to permit the greatest system efficiency.

Frank: Decision is normally based on economics. Considerations are also given to maintenance records, future company plans, and operating costs.

Pendleton: Rebuilding or replacing is always an economic decision. If you can get desired results without replacing equipment, that should be the course of action followed. The same is true when replacement of existing machinery is indicated.

Jacobs: We do continuing maintenance on our units and bring them up to date in planned programs. If all else fails, we consider replacement.

Upham: Our rebuilding, overhaul, and replacement programs are all by design. It goes back to age, condition, and efficiency.

P&GJ: *What product improvements have influenced you most?*

Jacobs: There have been several. Microprocessor units for controls and data acquisition. Fiber optics. Synthetic oils. We are always looking for products that will reduce wear or usage and provide fuel savings.

Pendleton: Improved fuel efficiency and reduced exhaust emission levels of prime movers have contributed significantly to the decision to modernize.

Upham: Improved gas turbines, improved engine-compressors, better compressor valves, synthetic oils, electronic controls.

Frank: Advances in electronics especially. We've replaced governors on all of our turbine units Microprocessor units have replaced pneumatic controls on some turbine units. New station discharge pressure controllers have been installed. A new communications system has been installed. Advances in lighting, heating and cooling systems for buildings, and new air filtering systems for turbines have contributed to the modernization decision.

Bayley: Use of fire resistant lubricants and oils in gas turbines has been a major advance. We were an early user of electronic control systems. We still use the original system in our stations for local control.

P&GJ: *What future product improvements would interest you?*

Pendleton: Further improvements in fuel efficiency and reduced emission levels of prime movers. A reduction in installed cost would be of great interest.

Jacobs: A good means for measuring throughput over the entire pipeline system. We would also like a means of recovering all of the waste heat from jacket water, lube oil, and prime mover exhaust. This heat energy could be sold for process use or used to generate electricity for sale to nearby electric utilities.

Frank: Compressor units with longer intervals between overhauls and greater efficiency would accelerate the decision to modernize. So would advancements in electronic controls and heat recovery systems.

Hood: Station controls and data gathering using microprocessors and programmable controllers.

Bayley: New machines of much more efficient design or equipment that can be adapted to existing machines to improve efficiency and lower fuel costs.

Upham: As more horsepower is required, we'll need more

What Does Compressor Horsepower Cost?

Cost data gathered by PIPELINE & GAS JOURNAL for both mainline compressor stations and for field and gathering system compressor stations reveals a broad cost range—depending on size and type of unit—as well as location, and whether or not it is an addition to an existing facility or a new facility.

Field and Gathering Gas Compressors Installed Cost—Typical Figures

HP	Type of Unit	Total Cost Per Unit	Cost Per Hp
40	Reciprocating	$48,000	$1200
100	Electric motor, recipr. compr.	120,000	1200
125	Recipr. engine, recipr. compr.	111,000	885
200	Recipr. engine, recipr. compr.	300,000	1500
1100	Gas turb., centrif. compr.	1,320,000	1200
1100	Gas turb., centrif. compr., with heat recovery	1,650,000	1500
600	Integral engine-compr.	900,000	1500
30	Integral engine-compr.	45,000	1500

Mainline Gas Compressors

Type Installed	HP	Total Cost	Cost Per HP	Compressor Cost Only, Per HP	Compressor Type
Addition	750	$ 1,176,700	$1568	$1037	Reciprocating
Addition	1160	1,028,000	886	555	Reciprocating
New	1500	7,523,000	2280	594	Reciprocating
Addition	2700	8,540,300	3163	1517	Reciprocating
Addition	2700	4,444,000	1646	407	Reciprocating
Addition	3800	2,534,975	687	n/a	Reciprocating
Addition	4000	10,977,000	2744	492	Reciprocating
New	5200	12,212,000	2348	n/a	Reciprocating
Addition	8000	14,400,000	1800	n/a	Reciprocating
Addition	3300	3,444,000	1043	502	Gas Turb./Centrif.
Addition	3300	6,118,960	1854	909	Gas Turb./Centrif.
New	19,000	23,924,410	1029	417	Gas Turb./Centrif.
New	38,000	39,109,791	1259	417	Gas Turb./Centrif.

powerful and efficient machines. That will hasten modernization and replacement decisions.

P&GJ: *When you modernize a station, what does it include?*
Frank: We've replaced controls, alarm systems, communications, and buildings. Governors have been replaced on all turbine engines. Microprocessor controls have been installed on several turbine units. Installation of microprocessor controls changes alarm systems. In the next few years, when several of our stations go unmanned, new communication systems will be needed. Remaining manned stations will have building expansions to accommodate the new remote control system.

New Products That Compressor Men Would Like to See in Next Few Years:

- Complete heat recovery systems.
- Lean burning compressor engines.
- Greater fuel efficiency in engines.
- Lower prime mover exhaust emissions.
- Advanced electronic controls.
- Advances in air filtering systems for turbines.
- System for measuring throughput between stations—that would also provide a better measure of operating efficiency and fuel cost.

Here's What P&GJ Seminar Respondents Plan to Do in 1984 and Next 3 Years:

Total No. of Stations operated by the respondents companies	201
No. of stations to be modernized in 1984:	15
No of stations to be modernized next 3 years	31
No. of compressor units that will be overhauled/rebuilt in 1984	9
No. of compressor units that will be overhauled/rebuilt in next 3 years	26
No. of compressor units to be replaced in 1984	4
No. of compressor units to be replaced in next 3 years	16
Estimated expenditures for modernization/ rebuilding/overhaul/replacement in 1984	$12,150,000
Estimated expenditures for modernization/ rebuilding/overhaul/replacement in next 3 years	$37,400,000

Bayley: We usually replace all valves and some controls. We poke around generally to see what needs replacement and upgrading. Alarm and shutdown systems are always kept current.
Upham: We replace what needs to be replaced. It varies greatly from station to station.
Hood: Our modernization involves replacing old equipment such as compressor units, buildings, foundations, and cooling towers. The older equipment is kept in operation until the new equipment is installed and operative. It is then removed.
Jacobs: We will probably replace some controls; unit valves and yard piping valves; the compressor valves, which are internal to the machines; some yard piping if it improves flexibility of operation. We upgrade and test regularly our alarm and shutdown systems. We have already eliminated wooden cooling towers and now use atmospheric units.
Pendleton: Every item in a compressor station is individually evaluated and replaced as needed. Reuse of material and equipment is done whenever feasible and economical.

P&GJ: *What effect do environmental concerns have on modernization decisions?*
Hood: Environmental concerns are generally improved when a decision is made to modernize. The latest, more modern equipment and technology is geared to lower emissions and noise control. We've not had any problems with permitting where a station is modernized.
Jacobs: They have a definite effect on horsepower replacement. New facilities have to meet current environmental codes.
Upham: We always anticipate that there might be a problem, especially if you are modernizing a station that, when built, was in the country and now is close to a town. We do whatever possible to avoid problems.
Pendleton: Environmental requirments must be met whenever new construction or changes occur at compressor stations. Exhaust emissions permitting is stringent in our area.
Bayley: We have made modifications to our compressor stations to meet federal spill regulations that have changed since our pipeline began its operations. A Spill Prevention Control and Countermeasure Plan has been completed for each location. A modified inlet silencer was installed on one aircraft derivative turbine engine to reduce the noise level. We've not had any problems with obtaining permits.

P&GJ: *What trends in compressors and prime movers do you see in 1984 and in the future?*
Jacobs: Most important consideration will be fuel economy.
Hood: Emphasis will be placed on cogeneration and waste heat recovery to generate electricity in conjunction with compressing gas.
Frank: More efficient units. Time between overhauls will be extended. Aircraft derivative units will retain their efficiencies for longer time periods. Large, variable speed electric-driven units in the 16,000-hp range could become economical.
Bayley: There should be a breakthrough in gas turbine efficiency in the very near future. This will involve higher firing temperatures and improved air compression.
Upham: There will be greater emphasis on the lean burning engines.
Pendleton: There will be active efforts to improving thermal efficiency and to lower exhaust emission levels. **P&GJ**

NOTE

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Cov. 1, p. 1, 22, 24, 26.